TIME AND RATE OF SYNTHESIS OF PHYTIN, INVERT SUGAR AND TOTAL SUGARS IN CORN GRAIN DURING THE REPRODUCTIVE PERIOD

BY
ERNEST BENTON EARLEY
B.S., Clemson College, 1928
M.S., Virginia Polytechnic Institute, 1929

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SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN
AGRONOMY IN THE GRADUATE SCHOOL OF
THE UNIVERSITY OF ILLINOIS, 1941

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Introduction

The chemistry of plants is being studied today not so much from the standpoint of total analysis as from the standpoint of complete fractionation of groups of compounds at one or more times during growth. This latter technique aids in the understanding of the part various elements and simple organic constituents play in the synthesis of complex organic compounds and affords a means by which the rate and mechanism of reactions may be determined. It was from this point of view that a study of time and rate of synthesis of phytin, invert sugar and total sugar in corn grain during the reproductive period was undertaken.

TIME AND RATE OF PHYTIN SYNTHESIS

The time of initiation of phytin synthesis in the developing corn ovule was not determined by this investigation. It was shown however, that phytin was present in the ovule prior to fertilization, although the concentration was only 0.015 percent. Phytin remained at this low level for two weeks after pollination, yet, by the ninth week it had increased to 0.271 percent, which represented 88.8 percent of the total phosphorus.

The weekly rate of phytin synthesis in the ovules increased from the second to the fourth week, diminished somewhat during the fifth week and all but ceased during the sixth week. The synthesis then rapidly increased during the seventh week after which there was no further formation of phytin in the grain. The maximum rate of synthesis occurred during the third week following pollination. During this period 18.9 milligrams of phytin phosphorus or 72.6 milligrams of phytic acid were formed daily per ear.

Formation of phytin during the first four weeks did not occur at the expense of non-phytin phosphorus stored in the ovules but was de-

pendent upon a reserve external supply in the stalks and leaves or in the culture medium which in this case was soil in the field. From the fourth to the tenth week stored non-phytin phosphorus contributed to the formation of phytin phosphorus during only the sixth and seventh week periods. For example, during the seventh week phytin phosphorus increased 177 milligrams in the grain per ear of corn while the non-phytin phosphorus decreased 71 milligrams per ear. The non-phytin phosphorus contributed therefore 40% of the phytin phosphorus leaving 60% to be supplied from sources external to the ovule.

In addition to finding phytin in unfertilized corn ovules it was also discovered in pollen and silks. The percentage in these materials was 0.017 and 0.045, respectively.

CARBOHYDRATES IN DEVELOPING CORN OVULES

Unpollinated ovules were found to contain, on a dry weight basis, 24.0 percent reducing sugars, 10.0 percent sucrose and 9.8 percent starch. Following pollination the percentage relationship of the carbohydrates rapidly changed so that by the third week the ovules contained 2.2 percent reducing sugars, 6.2 percent sucrose and 54.8 percent starch. From this time to the tenth, (final) week only small changes occurred among the percentages of these carbohydrates.

The inversion of the percentage relationships of total sugar and starch in the ovules during the first three weeks after pollination is the result of change of relative rapidity of sugar accumulation and starch synthesis and not to a conversion of accumulated sugars into starch. This statement is vindicated by the finding of an increase in milligrams of total sugar per ear during the time the percentage was decreasing. After this period of rapid change, i.e., from pollination to three weeks thereafter, starch synthesis and sugar intake about kept pace, since the large gains in amount of starch per ear were accompanied by a very slight change in quantity of sugar.

These facts demonstrate the necessity of continuous intake of sugars from outside the ovules during the entire period of starch synthesis.

RELATIONSHIP OF CARBOHYDRATES IN SILK AND POLLEN

Analyses of unpollinated silks from Station Reid yellow dent corn show 36.2 percent reducing sugars and 2.9 percent sucrose. Pollen from the same variety gave 1.4 percent reducing sugars and 9.8 percent sucrose. Whether high reducing sugars and low sucrose in corn silks and low reducing sugars and high sucrose in pollen bears any significance is not known at this time; however, it is believed this relationship has not been recorded heretofore.

VITA

The writer was born December 19, 1906 in Orangeburg County, South Carolina. He received his grade and high school education in the public schools of Orangeburg, S. C., graduating from the latter in June 1924. The following fall the writer enrolled in Clemson College, Clemson, South Carolina and was graduated from that institution in June 1928.

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